**Analysis of Criticality Accident Alarm System
Coverage in the X-700, X-705, and X-720 Facilities at
the Portsmouth Gaseous Diffusion Plant**

December 1995

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TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	2
2.0 FACILITY DESCRIPTIONS	3
2.1 The X-700 Maintenance Facility	3
2.2 The X-705 Decontamination Building	3
2.3 The X-720 Maintenance and Stores Facility	5
3.0 ANALYSIS	6
3.1 Facility Models	8
3.1.1 The X-700 Facility Model	8
3.1.2 The X-705 Facility Model	8
3.1.3 The X-720 Facility Model	14
3.2 Source Term	20
3.2.1 Source Locations	21
3.2.2 Source Power Level and Energy Spectrum	22
3.3 Flux Tallies	22
3.4 Variance Reduction	24
3.5 Flux to Absorbed Dose Rate Conversion	24
4.0 RESULTS	28
5.0 DISCUSSION	30

TABLE OF CONTENTS (cont.)

	Page
6.0 CONCLUSION	32
7.0 REFERENCES	33
APPENDIX A SAMPLE MCNP INPUTS FOR THE X-700, X-705, AND X-720 MODELS	34
APPENDIX B ABSORBED DOSE RATE CALCULATION SPREADSHEETS	49

LIST OF TABLES

	Page
1. Material Compositions	20
2. Criticality Accident Source Locations in X-700 Model	21
3. Criticality Accident Source Locations in X-705 Model	21
4. Criticality Accident Source Locations in X-720 Model	22
5. Source Terms for 100% Enriched ^{235}U Sources	23
6. Criticality Accident Source Neutron Production Rates	25
7. Henderson Free-in-Air Tissue Kerma Factors	27
8. Detector Response for the X-700 Model	28
9. Detector Responses for the X-705 Model	29
10. Detector Responses for the X-720 Model	29

LIST OF FIGURES

	Page
1. Layout of X-700, X-705, and X-720 Facilities and the Locations of the CAAS Detectors in Each Facility	7
2. Schematic Drawing of the X-700 Facility Model and the Locations of the CAAS Detector and Modeled Sources	9
3. SABRINA Plot of the X-700 Facility Model	10
4. Schematic Drawing of the X-705 Facility Model and the Locations of the CAAS Detectors and Modeled Sources	11
5. SABRINA Plot of the X-705 Facility Model Showing the First and Mezzanine Floor Levels	12
6. SABRINA Plot of the X-705 Facility Model Showing the First Floor Level Only	13
7. SABRINA Plot of the X-705 Facility Model Showing the Tunnel Basement, Pipe Trench, and Detector Locations	15
8. SABRINA Plot of the X-705 Facility Model Showing the Tunnel Basement and Sump, Pipe Trench, and East Detector	16
9. Schematic Drawing of the X-720 Facility Model and the Locations of the CAAS Detectors and Modeled Sources	17
10. SABRINA Plot of the X-720 Facility Model	18
11. SABRINA Plot of the Southeast Corner X-720 Facility Model	19

EXECUTIVE SUMMARY

Additional services for the uranium enrichment cascade process, such as maintenance and decontamination operations, are provided by several ancillary facilities at the PORTS site. These facilities include the X-700 Maintenance Facility, the X-705 Decontamination Facility, and the X-720 Maintenance and Stores Facility. As uranium operations are performed within these facilities, the potential for a criticality accident exists. In the event of a criticality accident within one of these facilities at PORTS, a Criticality Accident Alarm System (CAAS) is in place to detect the criticality accident and sound an alarm. In this report, an analysis was performed to provide verification that the existing CAAS at PORTS provides complete criticality accident coverage in the X-700, X-705, and X-720 facilities. The analysis has determined that the X-705 and X-720 facilities have complete CAAS coverage; the X-700 facility has not been shown to have complete CAAS coverage at this time.

1.0 INTRODUCTION

The Portsmouth Gaseous Diffusion Plant (PORTS), located near Piketon, Ohio, is one of two operating gaseous diffusion plants leased from the U.S. Department of Energy (DOE) by the United States Enrichment Corporation (USEC) and managed and operated by Lockheed Martin Utility Services (LMUS). At these plants, uranium (U), in the form of uranium hexafluoride (UF_6), is enriched through a gaseous diffusion process from its naturally occurring isotopic concentration of 0.7% ^{235}U up to about 5% ^{235}U with a plant maximum of 10% ^{235}U . The diffusion cascade process equipment is housed in Buildings X-333, X-330, and X-326. Support services, such as maintenance and decontamination operations, are provided by ancillary facilities at the PORTS site. These facilities include the X-700 Maintenance Facility, the X-705 Decontamination Facility, and the X-720 Maintenance and Stores Facility.¹

As uranium operations are performed within the process facilities at PORTS, the potential for a criticality accident exists. In the event of a criticality accident within a facility at PORTS, a Criticality Accident Alarm System (CAAS) is in place to detect the criticality accident and sound an alarm. According to ANSI standard ANS-8.3-1986² "American National Standard Criticality Accident Alarm System," the CAAS "shall be designed to detect immediately the minimum accident of concern." In order to meet this requirement, CAAS detectors are located at various positions throughout all of the cascade process buildings and in some of the support services buildings at PORTS. In this report, an analysis was performed to provide verification that the existing CAAS at PORTS provides complete criticality accident coverage in the X-700, X-705, and X-720 facilities.

2.0 FACILITY DESCRIPTIONS

Maintenance and decontamination facilities which provide support services for the ^{235}U enrichment cascade process at PORTS include the X-700 Maintenance Facility, the X-705 Decontamination Facility, the X-720 Maintenance and Stores Facility. These facilities, and the operations performed at each, are described briefly in the sections that follow.

2.1 The X-700 Maintenance Facility

The X-700 Converter Shop and Cleaning Building (the X-700 facility) is a permanent structure located about 250 feet north of the X-720 Maintenance Building and 200 feet east of the X-705 Chemical Operations Building.¹ The X-705 and X-700 buildings are located about 270 feet south of the X-333 Process Building.

The X-700 facility has a total floor area of about 104,000 square feet and is divided into two main sections. The east section is an equipment and parts cleaning area. The west section houses the Converter Shop which is divided into three subsections: north, south, and the west addition. These respective subsections are the Barrier Shop, the Converter/Weld Shop, and the Stabilization Stand. A new addition to the west side of the north barrier shop area, the Radiation Instrument Calibration Facility, was completed in 1986.¹ The X-700 facility contains one CAAS detector. This detector is located in the west subsection of the Converter Shop (the Stabilization Stand).^{3,4}

2.2 The X-705 Decontamination Building

The X-705 Chemical Operations Building (the X-705 facility) is centrally located with respect to the X-326, X-330, and X-333 Process Buildings and the X-700 and X-720 Maintenance Buildings.¹

The X-705 facility has a total floor area of about 85,000 square feet on the first floor and about 12,000 square feet on the mezzanine floor. The building houses four ancillary operations which support the decontamination and uranium recovery operations. These building services are the Process Laboratory, Maintenance Shop, Laundry, and Office Area. The X-705 Process Laboratory performs chemical analyses of solutions generated in X-705 and X-700. Solutions which are routinely analyzed include recovery solutions, decontamination solutions, chemical cleaning solutions, and waste water. Laundry personnel wash, dry, and sort personnel protective equipment and company issued clothing that is soiled or contaminated on plant site. The office area provides office space for the various operations personnel at the facility.^{1,5}

The X-705 decontamination operations consist of several processes which remove radioactive contamination from equipment and materials. The decontamination processes are designed to handle a wide range of equipment or material and types of radioactive contamination¹:

<u>Decontamination process</u>	<u>Equipment class</u>
UF ₆ cylinder decontamination, testing and reconditioning	UF ₆ cylinders
Truck alley decontamination	Oily/greasy equipment
Large parts disassembly and spray booths	Large parts (i.e., compressors)
South annex disassembly	Uranium/technetium highly-contaminated equipment
Seal disassembly room	Compressor seal assemblies or highly-contaminated equipment
Small parts handtable decontamination	Small parts or PG dust leaching
Fluorides complexing handtable	Uranyl fluoride/contaminated dusts and powders, and cylinder wash/rinse solutions
Glass blasting	Small parts with imbedded contamination
Spray tank decontamination	Uranium trap adsorbents or small parts

The X-705 facility contains two CAAS detectors. Both detectors are located on the first floor, one in the Recovery Area and one in the large Decontamination Bay.^{3,5}

2.3 The X-720 Maintenance and Stores Facility

The X-720 Maintenance and Stores Facility (the X-720 facility) is a permanent structure located about 300 feet south of the X-700 Maintenance Building and the X-705 Chemical Operations Building. The X-705 and X-700 buildings are located about 270 feet south of the X-333 Process Building.

The X-720 facility has a total floor area of about 284,000 square feet and is divided into two main sections. The north section of the X-720 facility contains the Machine Shop, the Compressor Shop, the Facilities Maintenance Shops, the Valve and Pump Shops, the Paint and Carpenter Shops, and the Electrical and Instrument Maintenance Shops. The south side of the X-720 facility contains the Main Stores Area, the Seal Shop, the Hydrostatic Test Shop, and a Toxic Materials Storage Area. The X-720 Building also houses a small bicycle repair shop on the east side and adjacent to the compressor shop.^{1,6} The X-720 facility contains two CAAS detectors. These detectors are located in the Motor Shop and the Compressor Shop.^{3,6}

3.0 ANALYSIS

To determine CAAS coverage in the X-700, X-705, and X-720 facilities, a model of each facility was developed. In each of these models, CAAS detectors were modeled at positions corresponding to the currently existing CAAS detectors. Next, neutron sources representing minimum criticality accidents were modeled at various locations throughout the facilities, and a detector response was calculated for each detector location. Finally, the calculated response of the detectors was used to determine CAAS coverage. If a criticality accident source location resulted in a detector response larger than the PORTS CAAS setpoint of 5 mrad/hr, then a criticality accident at that location would be detected and the CAAS coverage is determined to be adequate. If, however, the detector response was smaller than the PORTS CAAS setpoint, then a criticality accident at that source location may go undetected.

Currently, two CAAS detectors in each of the X-705 and X-720 facilities and one CAAS detector in the X-700 facility provide CAAS coverage within those facilities. These facilities and their CAAS detector locations are shown in Figure 1. Each facility provides its own CAAS coverage and is not relied upon to provide coverage for nearby buildings or facilities. Thus, each facility is modeled independently of the other facilities at PORTS. The analysis was performed using the Monte Carlo N-Particle transport code, MCNP4A.⁷

The development of the MCNP models and the analysis of the results were performed in five steps. First, a suitable geometry approximating each facility was developed. Second, an accurate source term describing an appropriate criticality accident was determined. Third, the CAAS detectors were modeled and flux tallies were implemented in a manner that provided an accurate value of the flux spectrum at the detector locations. Fourth, variance reduction techniques were employed such that the problem could be solved in a timely manner while still generating accurate results. Finally, a flux to dose conversion was applied to the tally results to determine the CAAS detector response. These five steps are described in detail in the sections that follow.

**Figure 1 — Layout of X-700, X-705, and X-720 Facilities
and the Locations of the CAAS Detectors in Each Facility**

December
1995

Final Report

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 7

3.1 Facility Models

3.1.1 The X-700 Facility Model

The X-700 facility was modeled as a single-story structure approximately 520-feet long by 200-feet wide (excluding additions). The building model was divided into a high bay over the cleaning area, and a low bay over the rest of the building, addition, and the calibration facility. The outside walls were modeled as full-density homogeneous concrete. The interior walls consist of 8-inch concrete block walls, which were modeled as half-density concrete. The calibration facility wall geometry was simplified and modeled as one room with three-foot thick concrete walls. The eight tanks located in the high bay cleaning area were simplified into one water-filled tank. A schematic drawing of the facility model is shown in Figure 2, while Figure 3 is a SABRINA⁸ plot of the X-700 facility model.

3.1.2 The X-705 Facility Model

The X-705 Facility was modeled as a two-story structure approximately 520-feet long by 160-feet wide by 34-feet tall. The facility model consists of an office/laboratory area and a large open bay area. The office/laboratory area is located on the east side of the building and consists of two stories of office/laboratory rooms. The stories are separated by a 5-inch thick solid concrete floor. The concrete floor does not cover all areas of the office/laboratory. In some locations the floor is discontinuous, providing access between the first and mezzanine (second) floors. Also, the mezzanine floor of the office/laboratory area does not completely cover the first floor. The second floor only exists over approximately the northern two-thirds of the office/laboratory area. These features are shown schematically in Figure 4, and also in Figures 5 and 6. Figure 5 is a SABRINA plot showing the model including the mezzanine level while Figure 6 is a SABRINA plot excluding the mezzanine level. All rooms in this area are separated by 8-inch concrete block walls. Concrete block was modeled as half-density concrete.

Figure 2 – Schematic Drawing of the X-700 Facility Model and the Locations of the CAAS Detector and Modeled Sources

Figure 3 – SABRINA Plot of the X-700 Facility Model

December
1995

Final Report

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 10

Figure 4 – Schematic Drawing of the X-705 Facility Model and the Locations of the CAAS Detectors and Modeled Sources

**Figure 5 – SABRINA Plot of the X-705 Facility Model
Showing the First and Mezzanine Floor Levels**

**Figure 6 – SABRINA Plot of the X-705 Facility
Model Showing the First Floor Level Only**

The bay area is located on the west side of the X-705 Building and is two stories in height. The turnover fixture pit in this area was modeled as a rectangle 20-feet long by 16-feet wide cut 12-feet deep into the concrete floor. The hatch covers located on the floor provide access to a tunnel basement and pipe trench. The tunnel basement was modeled as a large rectangle 244-feet long by 20-feet wide cut 20-feet deep into the concrete floor. The sumps in the tunnel basement were modeled as cylinders, 2-feet in diameter that extend 5-feet below the bottom of the tunnel basement. The sumps are located at the north and south ends of the tunnel. A 3-inch concrete layer covers the drainage trench (except for the hatch covers) and the sump pits. A cylindrical pipe tunnel 14-feet in diameter was modeled 5-feet below the X-705 floor. These features are also shown schematically in Figure 4 and in SABRINA plots of the facility model in Figures 7 and 8.

3.1.3 The X-720 Facility Model

The X-720 Facility was modeled as a single-story structure approximately 760-feet long by 370-feet wide by 40-feet tall. The facility model is comprised of the maintenance facilities on the north side of the building and the stores and test shop facilities on the south side of the building, separated by a concrete wall that runs the length of the building. The maintenance facilities consist of various structures dispersed throughout the north side of the building. The southern part of the building consists of the stores section, which is a large open room taking approximately three-fourths of the area, and test shops which occupy the remaining one-fourth of the area. The test shops are comprised of several smaller rooms. With the exception of the wall that separates the northern and southern portions of the building, all rooms and structures in the X-720 facility model are separated or constructed by 8-inch concrete block walls. Concrete block was modeled as half-density concrete. The wall that runs the length of the building and separates the northern and southern portions of the building was modeled as 12-inch thick, full-density concrete. Figure 9 is a schematic drawing of the facility model, and SABRINA plots of the facility model are shown in Figures 10 and 11.

Figure 7 – SABRINA Plot of the X-705 Facility Model Showing the Drainage Trench, Pipe Trench, and Detector Locations

Figure 8 – SABRINA Plot of the X-705 Facility Model Showing the Drainage Trench, Pipe Trench, One Detector, and One Source Location

Figure 9 – Schematic Drawing of the X-720 Facility Model and the Locations of the CAAS Detectors and Modeled Sources

Figure 10 – SABRINA Plot of the X-720 Facility Model

Figure 11 – SABRINA Plot of the Southeast Corner X-720 Facility Model

3.1.4 Material Compositions

For consistency with previous calculations of criticality alarm response in the PORTS buildings,⁹ the number densities of air, concrete, and steel used in this analysis were taken from Westfall et al.¹⁰ These number densities are given in Table 1.

Table 1 — Material Compositions

Material	Element	Number Density (Atom/(barn*cm))
Air	Nitrogen	3.570E-05
	Oxygen	7.840E-06
Concrete	Hydrogen	1.487E-02
	Carbon	3.814E-03
	Oxygen	4.152E-02
	Sodium	3.040E-04
	Magnesium	5.870E-04
	Aluminum	7.350E-04
	Silicon	6.037E-03
	Calcium	1.159E-02
	Iron	1.968E-04
Steel	Carbon	3.921E-03
	Iron	8.349E-02

3.2 Source Term

To completely model the criticality sources used in the MCNP analysis, the source location, source neutron production rate (power level), and the source neutron energy spectra must be known. The development of each is discussed briefly below.

3.2.1 Source Locations

Source locations were chosen that would maximize the distance and/or shielding between the source and the detector. These source locations result in the smallest absorbed dose rates at the detectors. Therefore, any other source location would result in a smaller distance or smaller thickness of shielding between the source and detector and will be bounded by the cases analyzed. Several different source locations in each model were used in this analysis. These source locations are presented in Tables 2, 3, and 4 for the X-700, X-705 and X-720 models, respectively. These source locations in each facility are also shown in the respective facility model figures.

Table 2 — Criticality Accident Source Locations in X-700 Model

Source #	Description	U-235 Enrichment (%)	Power Level (W)
S1	East side of building behind water tank	100	1281
S2	Northeast corner of building	100	1281
S3	Northwest corner of building	100	1281
S4	50-feet east of building (outside of building)	100	1281
S5	Southeast corner of building	100	1281

Table 3 — Criticality Accident Source Locations in X-705 Model

Source #	Description	U-235 Enrichment (%)	Power Level (W)
S1	Northeast corner of building on the mezzanine floor	100	1281
S2	Southwest area of the mezzanine floor	100	1281
S3	Northeast corner of building on the first floor	100	1281
S4	Darkroom in the eastern part of the building on the first floor	100	1281
S5	Southeast corner of building on the first floor	100	1281
S6	50-feet west of northwest corner of building (outside of building)	100	1281

Table 4 — Criticality Accident Source Locations in X-720 Model

Source #	Description	U-235 Enrichment (%)	Power Level (W)
S1	Southeast corner of building	100	1281
S2	South side of building in floor pit	100	1281
S3	100-feet south of the X-720 west wall (outside of building)	100	1281
S4	100-feet east of the X-720 south wall (outside of building)	100	1281

3.2.2 Source Power Level and Energy Spectrum

The criticality source used in this analysis was one that results in the minimum critical accident of concern as defined in ANSI/ANS 8.3-1986.² Criticality accidents that may occur in different locations in the plant will most likely result from material enriched to different levels. However, all of the buildings examined handle uranium enriched to 100%; therefore, only 100% enriched ²³⁵U sources were used in these calculations.¹¹

The power level and source neutron energy spectrum for the source used was taken from POEF-SH-31.¹¹ The power level for the criticality accident source used in the analysis is shown in Tables 2, 3, and 4. The source neutron energy spectrum for the criticality accident source modeled is listed in Table 5. With the exception of the source for point S6 in the X-705 analysis, all sources were modeled as isotropic point sources.

3.3 Flux Tallies

The CAAS detectors used at the PORTS site are set to alarm at an absorbed dose rate of 5 mrad/hr.¹² Values of the neutron flux in air, calculated by MCNP, will be converted to absorbed dose rates through the use of an appropriate flux to absorbed dose rate conversion factor (see section 3.5). Therefore, the detectors modeled in MCNP must tally the neutron flux spectra

Table 5 — Source Terms for 100% Enriched ^{235}U Sources

Upper Energy Limit (MeV)	Source Neutron Energy Spectra
2.00E+01	1.28E+03
6.43E+00	1.02E+04
3.00E+00	1.13E+04
1.85E+00	5.88E+03
1.40E+00	7.25E+03
9.00E-01	1.03E+04
4.00E-01	8.89E+03
1.00E-01	5.83E+03
1.70E-02	3.99E+03
3.00E-03	3.52E+03
5.50E-04	3.21E+03
1.00E-04	2.09E+03
3.00E-05	1.71E+03
1.00E-05	1.79E+03
3.05E-06	7.91E+02
1.77E-06	4.79E+02
1.30E-06	1.92E+02
1.13E-06	1.68E+02
1.00E-06	3.17E+02
8.00E-07	9.66E+02
4.00E-07	2.74E+02
3.25E-07	4.84E+02
2.25E-07	1.29E+03
1.00E-07	1.28E+03
5.00E-08	7.14E+02
3.00E-08	5.67E+02
1.00E-08	1.04E+02
1.00E-11	0.00E+00

in air. The MCNP detectors were modeled as spheres with a 1-m diameter at locations corresponding to the currently installed CAAS detectors.³ The neutron fluence per source particle at the various detectors was tallied using a next event estimator (point detector) at the center of the detector spheres.

3.4 Variance Reduction

Because the neutrons tracked in the Monte Carlo simulations have low probabilities of reaching a detector, the large size of the buildings coupled with the number of concrete structures in-between the sources and the detectors could result in calculations that require an enormous amount of computer time. To avoid extremely long computation times, variance-reduction techniques were used. The techniques included point detectors and energy cut off in a particle's random walk.

For the sixth source point in the X-705 analysis only, the minimum criticality accident neutron source was directionally biased. For a typical isotropic point source, the probability of a neutron leaving the source sphere from the half closest to the building would be $\frac{1}{2}$ and would carry a weighting factor of 1. For the directionally biased source point S6 in the X-705 analysis only, the probability of a source neutron leaving the source sphere from the half closest to the building was changed to 1 and the weighting factor changed to $\frac{1}{2}$. This reduced computational time while maintaining the accuracy required of the analysis.

3.5 Flux to Absorbed Dose Rate Conversion

MCNP was used to calculate the neutron fluence per source neutron at the modeled detector locations. In order to calculate the absorbed dose rate in the detectors, the neutron fluence per source neutron was first converted to neutron flux. Then, a flux to neutron absorbed dose rate conversion factor was applied.

To convert the neutron fluence per source particle to neutron flux, the neutron production rate (power level) of the source must be known. The source neutron production rate was determined according to the following equation:

$$N\left(\frac{n}{sec}\right) = \phi_p\left(\frac{n}{cm^2 \cdot sec \cdot W}\right) \times P(W) \times A(cm^2)$$

where

N = the source neutron production rate

ϕ_p = the neutron flux per unit power

P = power for the minimum critical accident of concern

A = the surface area of a sphere with 2-meter radius

Using the appropriate values for ϕ_p and P from POEF-SH-31, the neutron source rate for the source term was calculated. The neutron source rate for the criticality accident source modeled is shown in Table 6.

Table 6 — Criticality Accident Source Neutron Production Rates

U-235 Enrichment (%)	Power Level (W)	Neutron Production Rate (n/s)
100	1281	5.121×10^{13}

Next, a conversion factor was applied to the neutron flux to calculate the neutron absorbed dose rate. In this analysis, the neutron absorbed dose rate was calculated on a per energy bin basis. The absorbed dose rate at the detector was calculated using the following equation:

$$D\left(\frac{mrad}{hr}\right) = \sum_{i=1}^{27} N\left(\frac{n}{sec}\right) \times \phi_{i,MCNP}\left(\frac{\left(\frac{\#}{cm^2}\right)}{n}\right) \times k_i\left(\frac{rad}{\left(\frac{n}{cm^2}\right)}\right) \times \left(\frac{3600 sec}{hr}\right) \times \left(\frac{1000 mrad}{rad}\right)$$

where

D = neutron absorbed dose rate at detector

ϕ_{MCNP} = the neutron fluence per source particle at detector

N = source neutron production rate

k = neutron flux to neutron absorbed dose rate conversion factor

i = energy bin index

In this analysis, the Henderson Free in Air Tissue kerma factors,¹³ as shown in Table 7, were used.

Table 7 — Henderson Free-in-Air Tissue Kerma Factors

Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))
1.00E-11	0.00E+00
1.00E-08	6.03E-17
3.00E-08	2.46E-16
5.00E-08	3.69E-16
1.00E-07	6.52E-16
2.25E-07	1.40E-15
3.25E-07	2.54E-15
4.00E-07	3.37E-15
8.00E-07	5.39E-15
1.00E-06	8.37E-15
1.13E-06	9.93E-15
1.30E-06	1.13E-14
1.77E-06	1.42E-14
3.05E-06	2.20E-14
1.00E-05	5.46E-14
3.00E-05	1.70E-13
1.00E-04	5.43E-13
5.50E-04	2.36E-12
3.00E-03	1.35E-11
1.70E-02	7.20E-11
1.00E-01	3.12E-10
4.00E-01	1.08E-09
9.00E-01	1.79E-09
1.40E+00	2.44E-09
1.85E+00	2.79E-09
3.00E+00	3.22E-09
6.43E+00	4.18E-09
2.00E+01	4.72E-09

4.0 RESULTS

The decontamination facilities were analyzed in three separate models, the X-700, X-705, and the X-720 models. Sample MCNP input files for all three models are included in Appendix A. In the analysis for each model, a source was placed at various source locations and the fluence per source neutron value for each individual detector in the model was calculated. These values were then converted to absorbed dose rates using the methodology presented in section 3.5. These calculations are included in Appendix B.

For a given source location, the distance and/or amount of shielding between the source and a detector varies with the detector location. As a result, in the MCNP analysis, one detector may arrive at a statistically significant fluence per source neutron value, fractional uncertainty of about 5%, more quickly than the others.

Detector responses for each source location are presented in Tables 8, 9, and 10 for the X-700, X-705, and the X-720 models, respectively. All detector responses are given for every source location. Even though the east detector alarmed for all source locations examined in the X-720 facility, the west detector is still required to make the statement that full coverage is provided. This is to obtain coverage of the northwest corner, outside the facility.

Table 8 — Detector Response for the X-700 Model

Source Location	Detector Response $\pm$ Standard Deviation (mrad/hr)
	Detector X700 (9a-A5)
S1	2.9 ± 0.2
S2	0.46 ± 0.04
S3	5.6 ± 0.9
S4	3.8 ± 0.2
S5	1.3 ± 0.1

Table 9 — Detector Responses for the X-705 Model

Source Location	Detector Response $\pm$ Standard Deviation (mrad/hr)	
	Detector X705-S (19-G)	Detector X705-E (8-B)
S1	16.7 ± 0.4	14.2 ± 0.9
S2	1648 ± 17	51.6 ± 3.9
S3	5.0 ± 0.2	47.5 ± 3.1
S4	47.5 ± 4.0	32.2 ± 27.0
S5	255 ± 2	61.8 ± 3.8
S6	23.7 ± 0.9	3.3 ± 0.3

Table 10 — Detector Responses for the X-720 Model

Source Location	Detector Response $\pm$ Standard Deviation (mrad/hr)	
	Detector X720-E (G-16)	Detector X720-W (J-11)
S1	6.9 ± 0.1	0.23 ± 0.02
S2	171 ± 1	5.9 ± 0.1
S3	5.2 ± 0.1	0.41 ± 0.03
S4	9.1 ± 0.2	0.55 ± 0.02

5.0 DISCUSSION

In the analysis of CAAS coverage in the decontamination facilities, source locations were chosen which would minimize detector response and which were also credible criticality accident locations. Due to the conservative nature of the selected source locations, all other locations within the range of selected source locations will result in a higher detector response and will, therefore, be bounded by these source locations.

The analysis determines coverage or non-coverage of a location by comparing calculated detector responses to the PORTS CAAS alarm setpoint of 5 mrad/hr. MCNP was run using point detectors to tally the neutron fluence per source particle. The problem was run until the tally for one of the detectors had a fractional uncertainty of about 5%. At this point the response of this detector was calculated as outlined in section 3.5. If the calculated detector response was greater than or equal to 5 mrad/hr, the area was then considered to be covered by the CAAS. Using this method, the decontamination and maintenance facilities X-705 and X-720 are completely covered for the source points chosen; however, coverage of the X-700 facility could not be shown at this time. Additionally, source points were selected that could be used to show that roads surrounding the periphery of the X-705 and X-720 buildings are also covered.

Full coverage of the X-700 Building could not be shown with the time resources available. A more accurate treatment of the detector response function that more appropriately treats the response generated by thermal neutrons could raise the absorbed dose values, thus showing coverage. This, however, was not modeled and was outside the scope of this analysis. As an alternative, simply relocating the X-700 detector to a more central location in the facility might also allow coverage to be shown. This, however, would require additional analysis.

The major contributors to the low detector absorbed dose rates include the distances between the sources used in the evaluation and the detector, and the number of concrete walls that had to be penetrated before a neutron could reach the detector. Source points in the NE and SE corners as well as the source on the road east of the building showed very low detector

response. The source in the NW corner (closest to the detector) showed the highest detector response (5.6 mrad/hr) but the error is still too high and additional computer calculations are required before coverage can be shown. The source located on the floor behind the cleaning tanks shows a moderate response, but still did not pass.

6.0 CONCLUSION

The CAAS detectors at PORTS are set to alarm at an absorbed dose rate of 5 mrad/hr. As can be seen from the absorbed dose rate values presented in Tables 9 and 10, the CAAS provides complete coverage of the decontamination and maintenance facilities X-705 and X-720 and of the roads around the periphery of these facilities. Full coverage of the X-700 facility cannot be shown at this time.

7.0 REFERENCES

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APPENDIX A

SAMPLE MCNP INPUTS FOR THE X-700, X-705, AND X-720 MODELS

December
1995

Final Report

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 34

x-700

c

c *****

c

c cell cards

c

c *****

c

c

c cell# material# -density surfaces importance

c

10	10	7.9654e-2	-60 50 -998	imp:n=1	\$ concrete
20	10	7.9654e-2	10 -18 39 -40 60 -65	imp:n=1	\$ swm wall-1
25	10	7.9654e-2	13 -20 39 -40 60 -65	imp:n=1	\$ swm wall-2
30	10	7.9654e-2	10 -20 30 -31 60 -70	imp:n=1	\$ sen wall
40	10	7.9654e-2	10 -11 31 -42 60 -70	imp:n=1	\$ wse wall-hb
45	10	7.9654e-2	10 -11 42 -39 60 -65	imp:n=1	\$ wse wall-lb
50	10	7.9654e-2	19 -20 31 -42 60 -70	imp:n=1	\$ wne wall-hb
55	10	7.9654e-2	19 -20 42 -39 60 -65	imp:n=1	\$ wne wall-lb
60	20	9.0726e-2	10 -20 30 -42 70 -71	imp:n=1	\$ roof-high bay
70	20	9.0726e-2	(10 -20 42 -40 65 -66):		
			(12 -14 40 -45 65 -66)	imp:n=1	\$ roof-low bay
80	10	3.4827e-2	11 -19 38 -42 60 -70	imp:n=1	\$ wall "D"
90	10	7.9654e-2	21 -22 33 -34 60 -61	imp:n=1	\$ so tank wall
100	10	7.9654e-2	21 -226 34 -35 60 -61	imp:n=1	\$ w1 tank wall
105	10	7.9654e-2	227 -24 34 -35 60 -61	imp:n=1	\$ w2 tank wall
106	10	7.9654e-2	227 -24 32 -33 60 -61	imp:n=1	\$ e2 tank wall
107	10	7.9654e-2	225 -226 33 -34 60 -61	imp:n=1	\$ si tank wall
108	10	7.9654e-2	227 -228 33 -34 60 -61	imp:n=1	\$ ni tank wall
110	10	7.9654e-2	23 -24 33 -34 60 -61	imp:n=1	\$ no tank wall
120	10	7.9654e-2	21 -226 32 -33 60 -61	imp:n=1	\$ e1 tank wall
130	30	4.354e-5	226 -227 32 -35 60 -61	imp:n=1	\$ air tank/tank
140	50	-1.0	(22 -225 33 -34 60 -61):		
			(228 -23 33 -34 60 -61)	imp:n=1	\$ water in tank
150	10	3.4827e-2	25 -26 31 -36 60 -70	imp:n=1	\$ storage room wall
160	10	3.4827e-2	25 -28 36 -37 60 -70	imp:n=1	\$ storage room wall
170	10	3.4827e-2	27 -28 31 -36 60 -70	imp:n=1	\$ storage room wall
180	30	4.354e-5	26 -27 31 -36 60 -70	imp:n=1	\$ air in storage room
190	30	4.354e-5	11 -21 31 -38 60 -70	imp:n=1	\$ south air
191	30	4.354e-5	21 -24 31 -32 60 -70	imp:n=1	\$ air tank/wall
192	30	4.354e-5	21 -24 35 -38 60 -70	imp:n=1	\$ middle air
193	30	4.354e-5	21 -24 32 -35 61 -70	imp:n=1	\$ air over tanks
194	30	4.354e-5	25 -28 37 -38 60 -70	imp:n=1	\$ west air
195	30	4.354e-5	24 -25 31 -38 60 -70	imp:n=1	\$ north air
196	30	4.354e-5	28 -19 31 -38 60 -70	imp:n=1	\$ air 7
200	10	3.4827e-2	13 -14 42 -39 60 -65	imp:n=1	\$ wall "9"
210	10	3.4827e-2	15 -16 41 -39 60 -65	imp:n=1	\$ stairs wall
220	10	3.4827e-2	17 -18 41 -39 60 -65	imp:n=1	\$ stairs wall
230	10	3.4827e-2	15 -18 43 -41 60 -65	imp:n=1	\$ stairs wall
240	30	4.354e-5	16 -17 41 -39 60 -65	imp:n=1	\$ air in stairwell
250	10	7.9654e-2	12 -29 40 -44 60 -65	imp:n=1	\$ addition wall
260	10	7.9654e-2	12 -14 44 -45 60 -65	imp:n=1	\$ addition wall
270	10	7.9654e-2	13 -14 40 -44 60 -65	imp:n=1	\$ addition wall
280	30	4.354e-5	29 -13 40 -44 60 -65	imp:n=1	\$ air in addition
290	10	7.9654e-2	80 -81 40 -47 60 -65	imp:n=1	\$ cal lab wall
300	10	7.9654e-2	80 -83 47 -48 60 -65	imp:n=1	\$ cal lab wall
305	10	7.9654e-2	82 -83 40 -47 60 -65	imp:n=1	
306	10	7.9654e-2	81 -82 40 -49 60 -65	imp:n=1	\$ cal lab wall
307	20	9.0726e-2	80 -83 40 -48 65 -66	imp:n=1	
310	30	4.354e-5	81 -82 49 -47 60 -65	imp:n=1	\$ air in cal lab
320	30	4.354e-5	(11 -15 42 -39 60 -65):		
			(15 -18 42 -43 60 -65):		
			(18 -13 42 -40 60 -65)	imp:n=1	\$ air in shop area
330	30	4.354e-5	14 -19 42 -39 60 -65	imp:n=1	\$ air in re-tubing area
350	30	4.354e-5	(-10:-30:20:45:71) 60 -998	imp:n=1	\$ outside air
351	30	4.354e-5	(10 -20 42 -40 66 -71):		
			(12 -14 40 -45 66 -71):		
			(80 -83 40 -48 66 -71)	imp:n=1	\$ air above lb
352	30	4.354e-5	(14 -80 40 -45 60 -71):		
			(80 -83 48 -45 60 -71):		
			(83 -20 40 -45 60 -71)	imp:n=1	\$ north air
353	30	4.354e-5	10 -12 40 -45 60 -71	imp:n=1	\$ south air

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 35

```

360 0          (998 -999):(-998 -50)  imp:n=1    $ internal world
370 0          999 imp:n=0

```

```

c  surface cards
c  note: dimensions in centimeters
c

```

```

10  px  0.0
11  px  38.1
12  px  7925
13  px  9917
14  px  9937
15  px  7315
16  px  7335
17  px  8496
18  px  8534
19  px  15811.5
20  px  15849.6
21  px  5791
22  px  5811
23  px  12517
24  px  12537
25  px  14529
26  px  14549
27  px  15220
28  px  15240
29  px  7945
80  px  11148
81  px  11239.4
82  px  13809.1
83  px  13900.545
225 px  9044
226 px  9064
227 px  9264
228 px  9284

```

```

c
30  py  0.0
31  py  38.1
32  py  91.0
33  py  110.3
34  py  1105
35  py  1125.0
36  py  675.0
37  py  713.0
38  py  2438
39  py  6057.9
40  py  6096
41  py  4877
42  py  2454
43  py  4839
44  py  10465
45  py  10485

```

```

c  46  py  9327  $ detector
47  py  7526.477
48  py  7617.917
49  py  6187.44

```

```

c
50  pz  -35.56  $ bottom of the concrete
60  pz  0.0      $ top of the concrete
61  pz  122
65  pz  1125.9
66  pz  1134.7
70  pz  1430.6
71  pz  1439.6
998 so  20000    $ internal world
999 so  30000    $ boundary of universe

```

```

c  *****
c
c  material cards
c
c  *****

```

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 36


```

c
m10 1001.50c 1.487e-2 $ concrete
    6012.50c 3.814e-3
    8016.50c 4.152e-2
    11023.50c 3.040e-4
    12000.51c 5.870e-4
    13027.50c 7.350e-4
    14000.50c 6.037e-3
    20000.51c 1.159e-2
    26000.50c 1.968e-4
m20 1001.50c 4.288e-2 $ roof
    6012.50c 1.812e-2
    8016.50c 1.896e-3
    26000.50c 2.783e-2
m30 7014.50c 3.57e-5 $ air
    8016.50c 7.840e-6
m50 1001.50c 2.0
    8016.50c 1.0 $ water

c
c
c
c *****
c
c peripherals
c
c *****
c
f5c Detector
f5:n 9866 9327 200 50
e0 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
    3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
    1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
    0.003 0.017 0.1 0.4 0.9 1.4
    1.85 3.0 6.43 20

c
sdef pos=9900 45 1 erg=dl
scl from h/u=120 100% enrichment normalized to 1281 W
si1 h 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
    3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
    1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
    0.003 0.017 0.1 0.4 0.9 1.4
    1.85 3.0 6.43 20
spl d 0 1.04e+2 5.67e+2 7.14e+2 1.28e+3 1.29e+3
    4.84e+2 2.74e+2 9.66e+2 3.17e+2 1.68e+2 1.92e+2
    4.79e+2 7.91e+2 1.79e+3 1.71e+3 2.09e+3 3.21e+3
    3.52e+3 3.99e+3 5.83e+3 8.89e+3 1.03e+4 7.25e+3
    5.88e+3 1.13e+4 1.02e+4 1.28e+3

mode n
c 17 keV cut off
cut:n j 0.017
ctme 1000
nps 90000000
c
prtmp 3j 4
print

```

This is a model of the X705 building

```

c
c
c
c
c *****
c      cell cards
c *****
c
c      air in first floor
c
10  10  4.354e-5  10  -55  615  -645  850  -860  imp:n=1 $
20  10  4.354e-5  10  -28  565  -612  850  -860  imp:n=1 $
30  10  4.354e-5  30  -35  585  -612  850  -860  imp:n=1 $
40  10  4.354e-5  30  -35  565  -580  850  -860  imp:n=1 $
50  10  4.354e-5  36  -69  565  -612  850  -860  imp:n=1 $
60  10  4.354e-5  56  -58  640  -645  850  -860  imp:n=1 $
70  10  4.354e-5  60  -69  640  -645  850  -860  imp:n=1 $
80  10  4.354e-5  56  -58  615  -635  850  -860  imp:n=1 $
90  10  4.354e-5  60  -69  615  -635  850  -860  imp:n=1 $
100 10  4.354e-5  ((70 -160 590 -645 850 -860):
(152 -160 565 -590 850 -860)) 950 imp:n=1 $
110 10  4.354e-5  162 -180 625 -645 850 -860 imp:n=1 $
120 10  4.354e-5  162 -180 575 -620 850 -860 imp:n=1 $
125 10  4.354e-5  (162 -182 565 -570 850 -860):
(182 -186 565 -605 850 -860):
(182 -184 605 -645 850 -860):
(186 -227 600 -605 850 -860):
(184 -227 625 -635 850 -860) imp:n=1 $
130 10  4.354e-5  185 -227 640 -645 850 -860 imp:n=1 $
140 10  4.354e-5  185 -195 610 -620 850 -860 imp:n=1 $
150 10  4.354e-5  196 -202 610 -620 850 -860 imp:n=1 $
160 10  4.354e-5  203 -210 610 -620 850 -860 imp:n=1 $
170 10  4.354e-5  212 -217 610 -620 850 -860 imp:n=1 $
180 10  4.354e-5  218 -220 610 -620 850 -860 imp:n=1 $
190 10  4.354e-5  222 -227 610 -620 850 -860 imp:n=1 $
200 10  4.354e-5  187 -199 565 -600 850 -860 imp:n=1 $
210 10  4.354e-5  200 -205 585 -595 850 -860 imp:n=1 $
215 20  3.9827e-2  199 -215 595 -600 850 -860 imp:n=1 $
220 10  4.354e-5  206 -214 585 -595 850 -860 imp:n=1 $
225 20  3.9827e-2  199 -215 580 -585 850 -860 imp:n=1 $
230 10  4.354e-5  200 -214 565 -580 850 -860 imp:n=1 $
240 10  4.354e-5  215 -227 565 -600 850 -860 imp:n=1 $
250 10  4.354e-5  228 -244 565 -645 850 -860 imp:n=1 $
260 10  4.354e-5  245 -260 565 -645 850 -860 imp:n=1 $
270 10  4.354e-5  135 -150 585 -587 850 -860 imp:n=1 $
280 10  4.354e-5  (70 -130 560 -587 850 -880):
(130 -150 580 -587 860 -880) imp:n=1 $
290 10  4.354e-5  130 -150 560 -580 850 -880 imp:n=1 $
300 10  4.354e-5  ((5 -260 505 -560 850 -880)
(-50:90:-515:520:-850:860)) 960 imp:n=1 $
c
c      concrete and air between floors
c
310 20  7.9654E-2  (10 -69 565 -645 860 -870):
(69 -90 590 -645 860 -870):
(90 -110 590 -640 860 -870):
(100 -120 640 -645 860 -870):
(110 -140 617 -640 860 -870) imp:n=1 $
320 20  7.9654E-2  160 -172 565 -645 860 -870 imp:n=1 $
330 10  4.354e-5  90 -100 640 -645 860 -870 imp:n=1 $
340 10  4.354e-5  (110 -140 590 -617 860 -870):
(120 -140 640 -645 860 -870):
(140 -160 590 -645 860 -870):
(152 -160 565 -645 860 -870) imp:n=1 $
350 40  9.0726E-2  172 -262 565 -650 860 -865 imp:n=1 $
c
c      air in second floor
c
360 10  4.354e-5  (10 -58 565 -645 870 -880):
(58 -69 640 -645 870 -880) imp:n=1 $

```

December
1995

Final Report

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 38

```

370 10 4.354e-5 60 -69 565 -635 870 -880 imp:n=1 $
380 10 4.354e-5 (70 -160 590 -645 870 -880):
(152 -160 565 -590 870 -880) imp:n=1 $
390 10 4.354e-5 162 -170 565 -645 870 -880 imp:n=1 $
400 10 4.354e-5 172 -262 565 -650 865 -890 imp:n=1

```

c

c here are the walls

c

```

500 20 3.9827e-2 7 -10 612 -645 850 -880 imp:n=1 $
510 20 3.9827e-2 7 -10 565 -612 850 -880 imp:n=1 $
520 20 3.9827e-2 28 -30 585 -612 850 -860 imp:n=1 $
530 20 3.9827e-2 28 -30 565 -580 850 -860 imp:n=1 $
540 20 3.9827e-2 35 -36 585 -612 850 -860 imp:n=1 $
550 20 3.9827e-2 35 -36 565 -580 850 -860 imp:n=1 $
560 20 3.9827e-2 55 -56 640 -645 850 -860 imp:n=1 $
570 20 3.9827e-2 55 -56 615 -635 850 -860 imp:n=1 $
580 20 3.9827e-2 58 -60 640 -645 850 -860 imp:n=1 $
590 20 3.9827e-2 69 -70 640 -645 850 -860 imp:n=1 $
600 20 3.9827e-2 58 -60 615 -635 850 -860 imp:n=1 $
610 20 3.9827e-2 69 -70 615 -635 850 -860 imp:n=1 $
620 20 3.9827e-2 69 -70 590 -612 850 -860 imp:n=1 $
630 20 3.9827e-2 69 -70 565 -587 850 -880 imp:n=1 $
640 20 3.9827e-2 7 -172 645 -650 850 -880 imp:n=1 $
641 20 3.9827e-2 172 -262 645 -650 850 -860 imp:n=1 $
650 20 3.9827e-2 55 -70 635 -640 850 -860 imp:n=1 $
660 20 3.9827e-2 10 -70 612 -615 850 -860 imp:n=1 $
670 20 3.9827e-2 28 -36 580 -585 850 -860 imp:n=1 $
680 20 3.9827e-2 3 -70 560 -565 850 -880 imp:n=1 $
690 20 3.9827e-2 69 -152 587 -590 850 -880 imp:n=1 $
700 20 3.9827e-2 130 -135 585 -587 850 -860 imp:n=1 $
710 20 3.9827e-2 130 -150 580 -585 850 -860 imp:n=1 $
720 20 3.9827e-2 150 -262 560 -565 850 -880 imp:n=1 $
730 20 3.9827e-2 160 -182 570 -575 850 -860 imp:n=1 $
740 20 3.9827e-2 160 -182 620 -625 850 -860 imp:n=1 $
750 20 3.9827e-2 150 -152 580 -587 850 -880 imp:n=1 $
755 20 3.9827e-2 150 -152 565 -580 850 -880 imp:n=1 $
760 20 3.9827e-2 160 -162 565 -570 850 -860 imp:n=1 $
770 20 3.9827e-2 160 -162 575 -620 850 -860 imp:n=1 $
780 20 3.9827e-2 160 -162 625 -645 850 -860 imp:n=1 $
790 20 3.9827e-2 180 -182 625 -645 850 -860 imp:n=1 $
800 20 3.9827e-2 180 -182 575 -620 850 -860 imp:n=1 $
810 20 3.9827e-2 186 -187 565 -600 850 -860 imp:n=1 $
820 20 3.9827e-2 184 -185 610 -620 850 -860 imp:n=1 $
830 20 3.9827e-2 184 -185 640 -645 850 -860 imp:n=1 $
840 20 3.9827e-2 184 -228 605 -610 850 -860 imp:n=1 $
850 20 3.9827e-2 184 -228 620 -625 850 -860 imp:n=1 $
855 20 3.9827e-2 184 -228 635 -640 850 -860 imp:n=1 $
860 20 3.9827e-2 199 -200 565 -580 850 -860 imp:n=1 $
870 20 3.9827e-2 199 -200 585 -595 850 -860 imp:n=1 $
880 20 3.9827e-2 214 -215 565 -580 850 -860 imp:n=1 $
890 20 3.9827e-2 205 -206 585 -595 850 -860 imp:n=1 $
900 20 3.9827e-2 214 -215 585 -595 850 -860 imp:n=1 $
910 20 3.9827e-2 227 -228 565 -605 850 -860 imp:n=1 $
920 20 3.9827e-2 227 -228 610 -620 850 -860 imp:n=1 $
930 20 3.9827e-2 227 -228 625 -635 850 -860 imp:n=1 $
940 20 3.9827e-2 227 -228 640 -645 850 -860 imp:n=1 $
950 20 3.9827e-2 195 -196 610 -620 850 -860 imp:n=1 $
960 20 3.9827e-2 202 -203 610 -620 850 -860 imp:n=1 $
970 20 3.9827e-2 210 -212 610 -620 850 -860 imp:n=1 $
980 20 3.9827e-2 217 -218 610 -620 850 -860 imp:n=1 $
990 20 3.9827e-2 220 -222 610 -620 850 -860 imp:n=1 $
1000 20 3.9827e-2 244 -245 565 -645 850 -860 imp:n=1 $
1010 20 3.9827e-2 260 -262 565 -645 850 -860 imp:n=1 $
1020 20 3.9827e-2 260 -262 505 -560 850 -880 imp:n=1 $
1030 20 3.9827e-2 3 -262 500 -505 850 -880 imp:n=1 $
1040 20 3.9827e-2 50 -90 515 -520 850 -860 imp:n=1 $
1050 20 3.9827e-2 3 -5 505 -560 850 -880 imp:n=1 $

```

c

c second floor walls

c

```

1060 20 3.9827e-2 58 -60 565 -635 870 -880 imp:n=1 $

```

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 39

```

1070 20 3.9827e-2 58 -70 635 -640 870 -880 imp:n=1 $
1080 20 3.9827e-2 69 -70 640 -645 870 -880 imp:n=1 $
1090 20 3.9827e-2 69 -70 590 -635 870 -880 imp:n=1 $
1100 20 3.9827e-2 160 -162 565 -645 870 -880 imp:n=1 $
1110 20 3.9827e-2 170 -172 565 -645 870 -880 imp:n=1 $
c
c
c air outside bldg and roof
c
1200 10 4.354e-5 3 -7 565 -650 850 -890 imp:n=1 $
1210 40 9.0726E-2 (7 -172 500 -650 880 -890):
(3 -7 500 -565 880 -890):
(172 -262 500 -565 880 -890) imp:n=1 $
c
c here is basement stuff
c
1300 10 4.354e-5 58 -70 550 -555 825 -850 imp:n=1 $ turnover pit
1310 10 4.354e-5 545 -650 -920 imp:n=1 $ pipe tunnel
1320 10 4.354e-5 75 -197 525 -545 820 -830 imp:n=1 $ basement
1330 10 4.354e-5 -900 810 -820 imp:n=1 $ north sump
1340 10 4.354e-5 -910 810 -820 imp:n=1 $ south sump
1350 30 8.7411e-2 80 -85 530 -540 840 -850 imp:n=1 $ north hatch cover
1360 10 4.354e-5 80 -85 530 -540 830 -840 imp:n=1 $ air below hatch cover
1370 30 8.7411e-2 178 -186 530 -540 840 -850 imp:n=1 $ south hatch cover
1380 10 4.354e-5 178 -186 530 -540 830 -840 imp:n=1 $ air below hatch cover
1390 20 7.9654E-2 (3 -262 500 -650 830 -850)
(-58:70:-550:555)
(-80:85:-530:540)
(-178:186:-530:540) imp:n=1 $ layer 1 cement floor
1400 20 7.9654E-2 (3 -262 500 -650 825 -830)
(-58:70:-550:555)
(-75:197:-525:545)
(920:-545) imp:n=1 $ layer 2 (turnover pit)
1410 20 7.9654E-2 (3 -262 500 -650 820 -825)
(-75:197:-525:545)
(920:-545) imp:n=1 $ layer 3 (basement layer)
1420 20 7.9654E-2 (3 -262 500 -650 810 -820)
900 910 imp:n=1 $ layer 4 (sump layer)
1430 20 7.9654E-2 3 -262 500 -650 800 -810 imp:n=1 $ layer 5 (bottom concrete)
c
c detector cells
c
1450 10 4.354e-5 -950 imp:n=1 $ East detector col 8-B
1460 10 4.354e-5 -960 imp:n=1 $ South detector col 19-G
c
c giant mass of concrete
c
1500 20 7.9654E-2 800 -850 -1998
(-3:262:-500:650) imp:n=1 $ concrete mass
c
1510 10 4.354e-5 (-3:262:-500:650:890) 850 -1998 imp:n=1 $ giant air
c
1520 0 (-1998 -800):(1998 -1999) imp:n=1 $ internal world
1530 0 1999 imp:n=0 $ external world
c
c
c *****
c surface cards
c *****
c
3 px -30 $
5 px 0 $
7 px 580 $
10 px 610 $
c 20 px 1219 $
28 px 1809 $
30 px 1829 $
35 px 2256 $
36 px 2276 $
c 40 px 2438 $
50 px 3048 $

```

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 40

55	px	3231	\$	
56	px	3251	\$	
58	px	3638	\$	
60	px	3658	\$	
c	65	px	3851	\$
c	66	px	3871	\$
69	px	4237	\$	
70	px	4267	\$	
75	px	4554	\$	
80	px	4877	\$	
85	px	5334	\$	
90	px	5486	\$	
100	px	6096	\$	
110	px	6706	\$	
c	112	px	6797	\$
c	114	px	6889	\$
c	116	px	7224	\$
120	px	7315	\$	
130	px	7925	\$	
135	px	7945	\$	
140	px	8534	\$	
150	px	9144	\$	
152	px	9174	\$	
160	px	9754	\$	
162	px	9774	\$	
170	px	10363	\$	
172	px	10383	\$	
c	175	px	10607	\$
c	176	px	10627	\$
178	px	10851	\$	
180	px	10973	\$	
182	px	10993	\$	
184	px	11186	\$	
185	px	11206	\$	
186	px	11279	\$	
187	px	11299	\$	
c	190	px	11582	\$
c	192	px	11602	\$
195	px	11704	\$	
196	px	11724	\$	
197	px	12009	\$	
199	px	12172	\$	
200	px	12192	\$	
202	px	12283	\$	
203	px	12303	\$	
205	px	12558	\$	
206	px	12578	\$	
210	px	12802	\$	
212	px	12822	\$	
214	px	12954	\$	
215	px	12974	\$	
217	px	13107	\$	
218	px	13127	\$	
220	px	13411	\$	
222	px	13431	\$	
9c	224	px	13624	\$
c	225	px	13644	\$
227	px	13869	\$	
228	px	13889	\$	
c	230	px	14021	\$
c	240	px	14630	\$
244	px	14904	\$	
245	px	14924	\$	
c	249	px	15220	\$
c	250	px	15240	\$
260	px	15850	\$	
262	px	15880	\$	
500	py	-5516	\$	
505	py	-5486	\$	
c	510	py	-4877	\$
515	py	-4297	\$	

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 41

```

520 py -4267 $
525 py -4023 $
530 py -3932 $
c 535 py -3658 $
540 py -3322 $
545 py -3170 $
550 py -3048 $
555 py -2560 $
560 py -2438 $
565 py -2408 $
570 py -2194 $
575 py -2174 $
580 py -2042 $
585 py -2022 $
587 py -1859 $
590 py -1829 $
595 py -1768 $
600 py -1748 $
605 py -1646 $
610 py -1626 $
612 py -1534 $
615 py -1524 $
617 py -1372 $
620 py -1280 $
625 py -1260 $
c 630 py -1219 $
635 py -1067 $
640 py -1047 $
645 py -610 $
650 py -580 $
800 pz -3000 $ absolute bottom
810 pz -762 $ bottom of sump
820 pz -610 $ bottom of basement
825 pz -366 $ bottom of turnover pit
830 pz -7.62 $ bottom of flooring
840 pz -1.27 $ bottom of hatch
850 pz 0 $ ground level
860 pz 457.2 $ top of first floor
865 pz 459.74 $ top of first floor roof
870 pz 472.44 $ bottom of second floor
880 pz 1036.3 $ top of second floor
890 pz 1038.84 $ top of roof
c
c here are cylinders for sumps
c
900 c/z 4645 -3597 30.48 $ north sump
910 c/z 11918 -3597 30.48 $ south sump
c
920 c/y 7011 -366 213 $ pipe tunnel
c
c detector spheres
c
950 s 4318 -1219 100 50 $ east detector sphere col 8-B
960 s 10973 -4297 100 50 $ south detector sphere col 19-G
c
1998 so 8000000 $ internal world sphere
1999 so 1000000 $ external world sphere
c
c
c
c *****
c
c source term
c
c *****
c sdef pos=611 -611 473.44 erg=d1
c sdef sur=1998 nrm=-1 dir=d1
c sbl -21 2
c scl from h/u=120 100% enrichment normalized to 1281 W

```

December
1995

Final Report
*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 42

```

si1 h 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
      3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
      1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
      0.003 0.017 0.1 0.4 0.9 1.4
      1.85 3.0 6.43 20
spl d 0 1.04e+2 5.67e+2 7.14e+2 1.28e+3 1.29e+3
      4.84e+2 2.74e+2 9.66e+2 3.17e+2 1.68e+2 1.92e+2
      4.79e+2 7.91e+2 1.79e+3 1.71e+3 2.09e+3 3.21e+3
      3.52e+3 3.99e+3 5.83e+3 8.89e+3 1.03e+4 7.25e+3
      5.88e+3 1.13e+4 1.02e+4 1.28e+3

```

```

c
c
c *****
c
c material cards
c
c *****
c

```

```

m10 7014.50c 3.570e-5 $ air
      8016.50c 7.840e-6
m20 1001.50c 1.487e-2 $ concrete
      6012.50c 3.814e-3
      8016.50c 4.152e-2
      11023.50c 3.040e-4
      12000.51c 5.870e-4
      13027.50c 7.350e-4
      14000.50c 6.037e-3
      20000.51c 1.159e-2
      26000.50c 1.968e-4
m30 6012.50c 3.921e-3 $ steel
      26000.50c 8.349e-2
m40 1001.50c 4.288e-2 $ roof
      6012.50c 1.812e-2
      8016.50c 1.896e-3
      26000.50c 2.783e-2
m50 6012.50c 6.0 $ wood
      1001.50c 10.0
      8016.50c 5.0
m60 92238.50c 8.682e-3 $ UF6
      9019.50c 5.209e-2

```

```

c
c
c *****
c
c tally cards
c
c *****
c

```

```

fc4 east track detector col 8-B
f4:n 1450
fc5 east point detector col 8-B
f5:n 4318 -1219 100 1.0
fc14 south track detector col. 19-G
f14:n 1460
fc15 south point detector col. 19-G
f15:n 10973 -4297 100 1.0
e0 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
      3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
      1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
      0.003 0.017 0.1 0.4 0.9 1.4
      1.85 3.0 6.43 20

```

```

c
c
c *****
c
c peripheral cards
c
c *****
c
mode n

```

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 43

c 17 keV cut off
cut:n j 0.017
ctme 1440
c void
nps 1000000
prtmp 3j 4
c dbcn 31277116122605
print
c
c

December
1995

Final Report

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 44


```

x720 detector coverage examination
c source located in south east corner of building
c
10 2 3.9827e-2 80 -85 50 -60 90 -89 imp:n=1 $ s ext wall
20 2 3.9827e-2 -70 75 50 -60 90 -89 imp:n=1 $ n ext wall
30 2 3.9827e-2 50 -55 85 -75 90 -89 imp:n=1 $ w ext wall
40 2 3.9827e-2 65 -60 85 -75 90 -89 imp:n=1 $ e ext wall
50 2 7.9654e-2 (380 -390 400 -410 100 -90)
(-910:930:900:-920:-95:90) imp:n=1 $ concrete floor
100 2 3.9827e-2 120 -110 55 -65 90 -89 imp:n=1
110 2 3.9827e-2 130 -140 85 -120 90 -89 imp:n=1
120 2 3.9827e-2 150 -160 85 -120 90 -89 imp:n=1
130 2 3.9827e-2 230 -240 340 -360 90 -89 imp:n=1
140 2 3.9827e-2 170 -180 -360 85 90 -89 imp:n=1
150 2 3.9827e-2 190 -200 -280 85 90 -89 imp:n=1
160 2 3.9827e-2 210 -220 270 -360 90 -89 imp:n=1
170 2 3.9827e-2 210 -220 350 -120 90 -89 imp:n=1
180 2 3.9827e-2 -290 300 140 -150 90 -89 imp:n=1
190 2 3.9827e-2 -270 280 140 -150 90 -89 imp:n=1
200 2 3.9827e-2 -250 260 140 -150 90 -89 imp:n=1
210 2 3.9827e-2 160 -65 -350 360 90 -89 imp:n=1
220 2 3.9827e-2 160 -170 -340 330 90 -89 imp:n=1
230 2 3.9827e-2 160 -170 -290 300 90 -89 imp:n=1
240 2 3.9827e-2 190 -65 -270 280 90 -89 imp:n=1
250 1 4.3540e-5 55 -130 -120 85 90 -89 imp:n=1
260 1 4.3540e-5 140 -150 -120 250 90 -86 imp:n=1
270 1 4.3540e-5 140 -150 -260 270 90 -86 imp:n=1
280 1 4.3540e-5 140 -150 -280 290 90 -86 imp:n=1
290 1 4.3540e-5 140 -150 -300 85 90 -86 imp:n=1
300 1 4.3540e-5 160 -170 -300 85 90 -86 imp:n=1
310 1 4.3540e-5 160 -170 -330 290 90 -86 imp:n=1
320 1 4.3540e-5 160 -230 -360 340 90 -86 imp:n=1
330 1 4.3540e-5 240 -170 -360 340 90 -86 imp:n=1
340 1 4.3540e-5 160 -210 -120 350 90 -86 imp:n=1
350 1 4.3540e-5 220 -65 -120 350 90 -86 imp:n=1
360 1 4.3540e-5 (180 -190 85 -360 90 -86):
(190 -210 270 -360 90 -86) imp:n=1
370 1 4.3540e-5 -360 270 220 -65 90 -86 imp:n=1
380 1 4.3540e-5 200 -65 -280 85 90 -86 imp:n=1
390 2 3.9827e-2 55 -470 440 -450 -89 90 imp:n=1
400 2 3.9827e-2 460 -470 430 -440 -89 90 imp:n=1
410 2 3.9827e-2 55 -470 420 -430 -89 90 imp:n=1
420 1 4.3540e-5 55 -460 430 -440 -86 90 imp:n=1
430 2 3.9827e-2 480 -490 520 -75 90 -89 imp:n=1
440 2 3.9827e-2 480 -510 530 -520 90 -89 imp:n=1
450 2 3.9827e-2 500 -510 520 -75 90 -89 imp:n=1
460 1 4.3540e-5 490 -500 520 -75 90 -86 imp:n=1
470 2 3.9827e-2 820 -830 800 -440 90 -89 imp:n=1
480 2 3.9827e-2 840 -850 800 -440 90 -89 imp:n=1
490 2 3.9827e-2 820 -850 440 -450 90 -89 imp:n=1
500 2 3.9827e-2 820 -850 810 -800 90 -89 imp:n=1
510 1 4.3540e-5 830 -840 800 -440 90 -86 imp:n=1
520 2 3.9827e-2 860 -870 800 -440 90 -89 imp:n=1
530 2 3.9827e-2 880 -890 800 -440 90 -89 imp:n=1
540 2 3.9827e-2 860 -890 440 -450 90 -89 imp:n=1
550 2 3.9827e-2 860 -890 810 -800 90 -89 imp:n=1
560 1 4.3540e-5 870 -880 800 -440 90 -86 imp:n=1
570 2 3.9827e-2 700 -570 690 -680 90 -89 imp:n=1
580 2 3.9827e-2 700 -710 450 -690 90 -89 imp:n=1
590 2 3.9827e-2 720 -730 450 -690 90 -89 imp:n=1
600 1 4.3540e-5 710 -720 450 -690 90 -86 imp:n=1
610 2 3.9827e-2 700 -730 440 -450 90 -89 imp:n=1
620 2 3.9827e-2 540 -550 680 -530 90 -89 imp:n=1
630 2 3.9827e-2 560 -570 680 -530 90 -89 imp:n=1
640 2 3.9827e-2 540 -570 530 -520 90 -89 imp:n=1
650 1 4.3540e-5 550 -560 680 -530 90 -86 imp:n=1
660 2 3.9827e-2 580 -590 680 -530 90 -89 imp:n=1
670 2 3.9827e-2 580 -240 530 -520 90 -89 imp:n=1
680 2 3.9827e-2 230 -240 680 -530 90 -89 imp:n=1
690 2 3.9827e-2 580 -240 690 -680 90 -89 imp:n=1
700 1 4.3540e-5 590 -230 680 -530 90 -86 imp:n=1

```

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 45

```

710 2 3.9827e-2 190 -200 660 -75 90 -89 imp:n=1
720 2 3.9827e-2 190 -65 705 -660 90 -89 imp:n=1
730 1 4.3540e-5 200 -65 660 -75 90 -86 imp:n=1
740 2 3.9827e-2 630 -65 530 -520 90 -89 imp:n=1
750 2 3.9827e-2 620 -630 690 -520 90 -89 imp:n=1
760 1 4.3540e-5 630 -65 680 -530 90 -86 imp:n=1
770 2 3.9827e-2 630 -65 690 -680 90 -89 imp:n=1
780 2 3.9827e-2 190 -200 810 -450 90 -89 imp:n=1
790 2 3.9827e-2 200 -65 440 -450 90 -89 imp:n=1
800 2 3.9827e-2 200 -65 810 -800 90 -89 imp:n=1
810 1 4.3540e-5 200 -65 800 -440 90 -86 imp:n=1
820 1 4.3540e-5 380 -50 400 -410 90 -1110 imp:n=1
830 1 4.3540e-5 50 -60 70 -410 90 -1110 imp:n=1
840 1 4.3540e-5 60 -390 400 -410 90 -1110 imp:n=1
850 1 4.3540e-5 50 -60 400 -80 90 -1110 imp:n=1
860 2 3.9827e-2 55 -460 430 -440 86 -89 imp:n=1
870 2 3.9827e-2 490 -500 520 -75 86 -89 imp:n=1
880 2 3.9827e-2 830 -840 800 -440 86 -89 imp:n=1
890 2 3.9827e-2 870 -880 800 -440 86 -89 imp:n=1
900 2 3.9827e-2 710 -720 450 -690 86 -89 imp:n=1
910 2 3.9827e-2 550 -560 680 -530 86 -89 imp:n=1
920 2 3.9827e-2 590 -230 680 -530 86 -89 imp:n=1
930 2 3.9827e-2 200 -65 660 -75 86 -89 imp:n=1
940 2 3.9827e-2 630 -65 680 -530 86 -89 imp:n=1
950 2 3.9827e-2 200 -65 800 -440 86 -89 imp:n=1
960 2 3.9827e-2 140 -150 250 -120 86 -89 imp:n=1
970 2 3.9827e-2 140 -150 270 -260 86 -89 imp:n=1
980 2 3.9827e-2 140 -150 290 -280 86 -89 imp:n=1
990 2 3.9827e-2 140 -150 85 -300 86 -89 imp:n=1
1000 2 3.9827e-2 160 -170 85 -300 86 -89 imp:n=1
1010 2 3.9827e-2 160 -170 290 -330 86 -89 imp:n=1
1020 2 3.9827e-2 (180 -190 85 -360 86 -89):
(190 -210 270 -360 86 -89) imp:n=1
1030 2 3.9827e-2 160 -230 340 -360 86 -89 imp:n=1
1040 2 3.9827e-2 240 -170 340 -360 86 -89 imp:n=1
1050 2 3.9827e-2 160 -210 350 -120 86 -89 imp:n=1
1060 2 3.9827e-2 220 -65 350 -120 86 -89 imp:n=1
1070 2 3.9827e-2 220 -65 270 -360 86 -89 imp:n=1
1080 2 3.9827e-2 200 -65 85 -280 86 -89 imp:n=1
1090 1 4.3540e-5 910 -900 920 -930 95 -90 imp:n=1
1100 2 3.9827e-2 50 -60 80 -85 89 -1110 imp:n=1
1110 2 3.9827e-2 50 -55 85 -75 89 -1110 imp:n=1
1120 2 3.9827e-2 50 -60 75 -70 89 -1110 imp:n=1
1130 2 3.9827e-2 65 -60 85 -75 89 -1110 imp:n=1
1140 2 3.9827e-2 55 -65 120 -110 89 -1100 imp:n=1
1150 1 4.3540e-5 55 -65 110 -75 89 -1100 imp:n=1
1151 1 4.3540e-5 55 -65 85 -120 89 -1100 imp:n=1
1160 3 8.7411e-2 55 -65 85 -75 1100 -1110 imp:n=1
60 1 4.3540e-5 (480 -180 -75 110 90 -89)
(-530:510:-90:89)
(-820:450:850:-810:-90:89)
(-860:450:890:-810:-90:89)
(-540:520:570:-690:-90:89)
(-580:520:240:-690:-90:89)
(-700:680:730:-440:-90:89)
(2000)
(3000) imp:n=1
61 1 4.3540e-5 (180 -65 -75 110 90 -89)
(-190:-705:-90:89)
(-620:520:-690:-90:89)
(-190:450:-810:-90:89) imp:n=1
62 1 4.3540e-5 (55 -480 110 -75 90 -89)
(450:470:-420:-90:89) imp:n=1
80 0 (-100:1110:-380:390:-400:410) -999 imp:n=0 $ internal world
2000 1 4.354e-5 -2000 imp:n=1 $west detector sphere
3000 1 4.354e-5 -3000 imp:n=1 $east detector sphere
90 0 999 imp:n=0 $ external world

50 px -11582.4 $ outside west wall
55 px -11562.08 $ inside
60 px 11582.4 $ outside east wall

```

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 46

65	px	11562.08	\$ inside
70	py	5638.8	\$ outside north wall
75	py	5618.48	\$ inside
80	py	-5638.8	\$ outside south wall
85	py	-5618.48	\$ inside
86	pz	294.64	
89	pz	304.8	\$ ceiling
90	pz	0	\$ top of concrete floor
95	pz	-304.8	
100	pz	-457.2	\$ bottom of concrete floor
130	px	6685.28	
140	px	6705.6	
150	px	7904.48	
160	px	7924.8	
170	px	9123.68	
180	px	9144.0	
210	px	10342.88	
220	px	10363.2	
200	px	10038.08	
190	px	10017.76	
230	px	8818.88	
240	px	8839.2	
250	py	-2875.28	
260	py	-2895.6	
270	py	-3789.68	
280	py	-3810.0	
290	py	-4704.08	
300	py	-4724.4	
330	py	-3200.4	
340	py	-3180.08	
350	py	-2570.48	
360	py	-2590.8	
110	py	-1960.88	
120	py	-1981.2	
380	px	-20000	
390	px	20000	
400	py	-10000	
410	py	10000	
420	py	2001.52	
430	py	2021.84	
440	py	2590.8	
450	py	2611.12	
460	px	-10383.52	
470	px	-10363.2	
480	px	-9753.6	
490	px	-9733.28	
500	px	-7945.12	
510	px	-7924.8	
520	py	4419.6	
530	py	4399.28	
540	px	5486.4	
550	px	5506.72	
560	px	6380.48	
570	px	6400.8	
580	px	6705.6	
590	px	6725.92	
620	px	10820.4	
630	px	10840.72	
660	py	4744.72	
680	py	3200.4	
690	py	3180.08	
700	px	4724.4	
705	py	4724.4	
710	px	4744.72	
720	px	6228.08	
730	px	6248.4	
800	py	1412.24	
810	py	1391.92	
820	px	-6705.6	
830	px	-6685.28	
840	px	-5506.72	

Final Report

December
1995

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 47

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850 px      -5486.4
860 px      1219.5
870 px      1239.82
880 px      2418.38
890 px      2438.7
900 px      11430.0
910 px      9601.2
920 py      -894.08
930 py      20.32
1100 pz     1218.2
1110 pz     1219.2
2000 s      609.9 3220.72 120 50
3000 s      6705.6 1219.2 120 50
999 so      30000          $ boundary of internal world

mode n
sdef pos= 11560 -5615 100 erg=d1
scl from h/u=120 100% enrichment normalized to 1281 W
sil h 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
      3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
      1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
      0.003 0.017 0.1 0.4 0.9 1.4
      1.85 3.0 6.43 20
spl d 0 1.04e+2 5.67e+2 7.14e+2 1.28e+3 1.29e+3
      4.84e+2 2.74e+2 9.66e+2 3.17e+2 1.68e+2 1.92e+2
      4.79e+2 7.91e+2 1.79e+3 1.71e+3 2.09e+3 3.21e+3
      3.52e+3 3.99e+3 5.83e+3 8.89e+3 1.03e+4 7.25e+3
      5.88e+3 1.13e+4 1.02e+4 1.28e+3
fc4 west most detector (track length)
f4:n 2000
fc5 west most detector (point)
f5:n 609.9 3220.72 120 50
fcl4 east most detector (track length)
fl4:n 3000
fc15 east most detector (point)
fl5:n 6705.6 1219.2 120 50
e0 1.00e-11 1e-8 3e-8 5e-8 1e-7 2.25e-7 3.25e-7 4e-7 8e-7
    1e-6 1.13e-6 1.3e-6 1.77e-6 3.05e-6 1e-5 3e-5 1e-4 5.5e-4
    0.003 0.017 0.1 0.4 0.9 1.4 1.85 3.0 6.43 20
m1 7014.50c 3.570e-5 $ air
    8016.50c 7.840e-6
m2 1001.50c 1.487e-2 $ concrete
    6012.50c 3.814e-3
    8016.50c 4.152e-2
    11023.50c 3.040e-4
    12000.51c 5.870e-4
    13027.50c 7.350e-4
    14000.50c 6.037e-3
    20000.51c 1.159e-2
    26000.50c 1.968e-4
m3 6012.50c 3.921e-3 $ steel mixture
    26000.50c 8.349e-2
prdmp 3j 4
c 17 keV cut off
cut:n j 0.017
c void
c sdef sur=999 nrm=-1 dir=d1
c sbl -21 2
ctme 1500
nps 90000000
print

```

APPENDIX B

ABSORBED DOSE RATE CALCULATION SPREADSHEETS

December
1995

Final Report

*Analysis of Criticality Accident Alarm System Coverage in the X-700, X-705,
and X-720 Facilities at the Portsmouth Gaseous Diffusion Plant*

Page 49

Detector Response for the X-700 Building						
This source is located on the floor behind the cleaning tanks.						
	Upper Energy	Henderson Free in Air				
	Boundary (MeV)	Tissue Kerma Factor	9A-A5 Detector			
		(rads/(n/cm ²))	Neutron Fluence/sp	Relative Error	Absorbed Dose	Error
					Rate (rads/s)	
Source Rate (n/s)	1.00E-11			0		
5.47E+13	1.00E-08	6.03E-17		0	0	0
100% U-235	3.00E-08	2.46E-16		0	0	0
P = 1281 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	2.29E-12	0.4365	3.90821E-08	1.7059E-08
	4.00E-01	1.08E-09	2.96E-12	0.2786	1.74865E-07	4.8717E-08
	9.00E-01	1.79E-09	1.64E-12	0.0533	1.60577E-07	8.5588E-09
	1.40E+00	2.44E-09	8.19E-13	0.1235	1.0931E-07	1.35E-08
	1.85E+00	2.79E-09	5.10E-13	0.0777	7.78326E-08	6.0476E-09
	3.00E+00	3.22E-09	7.76E-13	0.048	1.3668E-07	6.5606E-09
	6.43E+00	4.18E-09	4.37E-13	0.151	9.99183E-08	1.5088E-08
	2.00E+01	4.72E-09	3.22E-14	0.056	8.31352E-09	4.6556E-10
				Total AD (rad/s)=	8.06579E-07	5.681E-08
				Total AD (mrad/hr) =	2.903684648	0.20451583

Detector Response for the X-700 Building						
This source is located in the NE corner of the building.						
	Upper Energy	Henderson Free in Air				
	Boundary (MeV)	Tissue Kerma Factor	9A-A5 Detector			
		(rads/(n/cm ²))	Neutron Fluence/sp	Relative Error	Absorbed Dose	Error
					Rate (rads/s)	
Source Rate (n/s)	1.00E-11			0		
5.47E+13	1.00E-08	6.03E-17		0	0	0
100% U-235	3.00E-08	2.46E-16		0	0	0
P = 1281 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	2.53E-13	0.2634	4.3178E-09	1.1373E-09
	4.00E-01	1.08E-09	3.48E-13	0.202	2.05584E-08	4.1528E-09
	9.00E-01	1.79E-09	4.06E-13	0.2528	3.97527E-08	1.0049E-08
	1.40E+00	2.44E-09	1.10E-13	0.1236	1.46815E-08	1.8146E-09
	1.85E+00	2.79E-09	8.50E-14	0.1526	1.29721E-08	1.9795E-09
	3.00E+00	3.22E-09	1.29E-13	0.1868	2.27213E-08	4.2443E-09
	6.43E+00	4.18E-09	5.13E-14	0.1103	1.17295E-08	1.2938E-09
	2.00E+01	4.72E-09	4.15E-15	0.1072	1.07146E-09	1.1486E-10
				Total AD (rad/s)=	1.27805E-07	1.2101E-08
				Total AD (mrad/hr) =	0.460097279	0.04356508

Detector Response for the X-700 Building						
The source is located in the NW corner (shadow of cal lab)						
	Upper Energy	Henderson Free in Air				
	Boundary (MeV)	Tissue Kerma Factor	9A-A5 Detector			
		(rads/(n/cm ²))	Neutron Fluence/sp	Relative Error	Absorbed Dose	Error
					Rate (rads/s)	
Source Rate (n/s)	1.00E-11			0		
5.47E+13	1.00E-08	6.03E-17		0	0	0
100% U-235	3.00E-08	2.46E-16		0	0	0
P = 1281 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	3.54E-12	0.07	6.04151E-08	4.2291E-09
	4.00E-01	1.08E-09	3.63E-12	0.11	2.14446E-07	2.3589E-08
	9.00E-01	1.79E-09	3.29E-12	0.16	3.22134E-07	5.1541E-08
	1.40E+00	2.44E-09	1.89E-12	0.27	2.52255E-07	6.8109E-08
	1.85E+00	2.79E-09	9.72E-13	0.14	1.4834E-07	2.0768E-08
	3.00E+00	3.22E-09	1.17E-12	0.08	2.06077E-07	1.6486E-08
	6.43E+00	4.18E-09	1.48E-12	0.65	3.38396E-07	2.1996E-07
	2.00E+01	4.72E-09	4.32E-14	0.17	1.11535E-08	1.8961E-09
				Total AD (rad/s)=	1.55322E-06	2.3866E-07
				Total AD (mrad/hr) =	5.591575695	0.85916851

Detector Response for the X-700 Building						
This source is located 50 ft east of the building.						
	Upper Energy	Henderson Free in Air				
	Boundary (MeV)	Tissue Kerma Factor	9A-A5 Detector			
		(rads/(n/cm ²))	Neutron Fluence/sp	Relative Error	Absorbed Dose	Error
					Rate (rads/s)	
Source Rate (n/s)	1.00E-11			0		
5.47E+13	1.00E-08	6.03E-17		0	0	0
100% U-235	3.00E-08	2.46E-16		0	0	0
P = 1281 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	2.95E-12	0.1824	5.03459E-08	9.1831E-09
	4.00E-01	1.08E-09	2.80E-12	0.1161	1.65413E-07	1.9204E-08
	9.00E-01	1.79E-09	2.56E-12	0.143	2.50657E-07	3.5844E-08
	1.40E+00	2.44E-09	9.79E-13	0.0588	1.30665E-07	7.6831E-09
	1.85E+00	2.79E-09	6.66E-13	0.0994	1.0164E-07	1.0103E-08
	3.00E+00	3.22E-09	1.10E-12	0.0879	1.93747E-07	1.703E-08
	6.43E+00	4.18E-09	6.68E-13	0.0687	1.52736E-07	1.0493E-08
	2.00E+01	4.72E-09	8.64E-14	0.0429	2.23071E-08	9.5697E-10
				Total AD (rad/s)=	1.06751E-06	4.7959E-08
				Total AD (mrad/hr) =	3.843041096	0.1726531

Detector Response for the X-700 Building						
This source is located in the SE corner of the building.						
	Upper Energy	Henderson Free in Air				
	Boundary (MeV)	Tissue Kerma Factor	9A-A5 Detector			
		(rads/(n/cm ²))	Neutron Fluence/sp	Relative Error	Absorbed Dose	Error
					Rate (rads/s)	
Source Rate (n/s)	1.00E-11			0		
5.47E+13	1.00E-08	6.03E-17		0	0	0
100% U-235	3.00E-08	2.46E-16		0	0	0
P = 1281 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	5.72E-13	0.1512	9.76198E-09	1.476E-09
	4.00E-01	1.08E-09	1.20E-12	0.2578	7.08912E-08	1.8276E-08
	9.00E-01	1.79E-09	8.80E-13	0.1761	8.61634E-08	1.5173E-08
	1.40E+00	2.44E-09	3.89E-13	0.0968	5.19191E-08	5.0258E-09
	1.85E+00	2.79E-09	2.17E-13	0.0774	3.3117E-08	2.5633E-09
	3.00E+00	3.22E-09	3.71E-13	0.0952	6.53986E-08	6.2259E-09
	6.43E+00	4.18E-09	1.89E-13	0.0862	4.32141E-08	3.7251E-09
	2.00E+01	4.72E-09	1.93E-14	0.0728	4.98295E-09	3.6276E-10
				Total AD (rad/s)=	3.65448E-07	2.5515E-08
				Total AD (mrad/hr) =	1.315613856	0.09185376

Detector Response for the X-705 Facility										
The source is located on the mezzanine, ne corner of recovery. (705_1)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Southern Det.(19g) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Det.(8b) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	1.38E-11	0.0738	2.34664E-07	1.73E-08	9.11E-12	0.1835	1.55383E-07	2.85E-08
	4.00E-01	1.08E-09	1.50E-11	0.068	8.86315E-07	6.03E-08	1.09E-11	0.1618	6.43085E-07	1.04E-07
	9.00E-01	1.79E-09	1.16E-11	0.0713	1.13415E-06	8.09E-08	6.90E-12	0.1044	6.7505E-07	7.05E-08
	1.40E+00	2.44E-09	5.34E-12	0.0381	7.12678E-07	2.72E-08	3.99E-12	0.2423	5.32511E-07	1.29E-07
	1.85E+00	2.79E-09	2.97E-12	0.0464	4.52705E-07	2.1E-08	2.67E-12	0.1376	4.07558E-07	5.61E-08
	3.00E+00	3.22E-09	3.78E-12	0.0277	6.6511E-07	1.84E-08	5.69E-12	0.1422	1.00107E-06	1.42E-07
	6.43E+00	2.06E-09	2.06E-12	0.0255	4.71292E-07	1.2E-08	2.04E-12	0.1236	4.67167E-07	5.77E-08
	2.00E+01	4.72E-09	3.66E-13	0.17	9.43692E-08	1.6E-08	2.80E-13	0.3315	7.21729E-08	2.39E-08
Total AD (rad/s)=					4.65128E-06	1.11E-07	Total AD (rad/s)=		3.954E-06	2.46E-07
Total AD (mrad/hr) =					16.74461974	0.400737	Total AD (mrad/hr) =		14.2344033	0.885997

[illegible]

[illegible]

Detector Response for the X-705 Facility										
The source is located in the laundry, in the extreme south east corner. (705_4)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Southern Det.(19g) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Det.(8b) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	2.73E-11	0.1134	4.66484E-07	5.29E-08	1.21E-13	0.3444	2.06873E-09	7.12E-10
	4.00E-01	1.08E-09	3.28E-11	0.1727	1.93756E-06	3.35E-07	2.45E-11	0.9846	1.44933E-06	1.43E-06
	9.00E-01	1.79E-09	3.03E-11	0.1511	2.96562E-06	4.48E-07	7.54E-11	0.9981	7.38081E-06	7.37E-06
	1.40E+00	2.44E-09	1.61E-11	0.1435	2.14357E-06	3.08E-07	8.84E-14	0.4327	1.17979E-08	5.1E-09
	1.85E+00	2.79E-09	1.44E-11	0.4037	2.20242E-06	8.89E-07	1.11E-13	0.3257	1.68761E-08	5.5E-09
	3.00E+00	3.22E-09	1.14E-11	0.077	2.01265E-06	1.55E-07	1.75E-13	0.2389	3.07898E-08	7.36E-09
	6.43E+00	4.18E-09	5.62E-12	0.0467	1.28405E-06	6E-08	2.16E-13	0.5105	4.93355E-08	2.52E-08
	2.00E+01	4.72E-09	6.57E-13	0.1082	1.69563E-07	1.83E-08	2.67E-14	0.0868	6.8959E-09	5.99E-10
				Total AD (rad/s)=	1.31819E-05	1.11E-06		Total AD (rad/s)=	8.94791E-06	7.5E-06
				Total AD (mrad/hr) =	47.45487717	3.990417		Total AD (mrad/hr) =	32.21246928	27.0136

Detector Response for the X-705 Facility										
The source is located in the lab, in the extreme south east corner. (705_5)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm^2))	Southern Det (19g) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Det (8b) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	1.06E-10	0.062	1.80499E-06	1.12E-07	1.54E-11	0.1025	2.62997E-07	2.7E-08
	4.00E-01	1.08E-09	1.16E-10	0.0399	6.85278E-06	2.73E-07	2.45E-11	0.1056	1.44839E-06	1.53E-07
	9.00E-01	1.79E-09	9.78E-11	0.0318	9.56846E-06	3.04E-07	2.59E-11	0.097	2.53286E-06	2.46E-07
	1.40E+00	2.44E-09	5.31E-11	0.0357	7.08158E-06	2.53E-07	1.74E-11	0.2441	2.32459E-06	5.67E-07
	1.85E+00	2.79E-09	4.31E-11	0.0192	6.5732E-06	1.26E-07	1.63E-11	0.2979	2.4933E-06	7.43E-07
	3.00E+00	3.22E-09	1.07E-10	0.0182	1.89122E-05	3.44E-07	2.07E-11	0.0512	3.64927E-06	1.87E-07
	6.43E+00	4.18E-09	7.27E-11	0.0126	1.66159E-05	2.09E-07	1.72E-11	0.0827	3.93103E-06	3.25E-07
	2.00E+01	4.72E-09	1.28E-11	0.0548	3.30467E-06	1.81E-07	2.01E-12	0.071	5.17718E-07	3.68E-08
				Total AD (rad/s)=	7.07138E-05	6.74E-07		Total AD (rad/s)=	1.71602E-05	1.05E-06
				Total AD (mrad/hr) =	254.5696178	2.427838		Total AD (mrad/hr) =	61.77660642	3.775879

Detector Response for the X-705 Facility										
The source is located approximately 80 ft west of the nw corner of the building. (705_6)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Southern Det.(19g) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Det.(8b) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	1.81E-11	0.0573	3.08361E-07	1.77E-08	1.63E-12	0.1002	2.77658E-08	2.78E-09
	4.00E-01	1.08E-09	2.41E-11	0.154	1.42188E-06	2.19E-07	2.04E-12	0.1259	1.20439E-07	1.52E-08
	9.00E-01	1.79E-09	1.60E-11	0.0447	1.56663E-06	7E-08	1.82E-12	0.1552	1.78383E-07	2.77E-08
	1.40E+00	2.44E-09	7.80E-12	0.0449	1.04033E-06	4.67E-08	9.71E-13	0.2529	1.29517E-07	3.28E-08
	1.85E+00	2.79E-09	4.02E-12	0.0413	6.13601E-07	2.53E-08	5.22E-13	0.1269	7.96168E-08	1.01E-08
	3.00E+00	3.22E-09	5.20E-12	0.0458	9.15609E-07	4.19E-08	1.45E-12	0.2378	2.54897E-07	6.06E-08
	6.43E+00	4.18E-09	2.75E-12	0.0245	6.27554E-07	1.54E-08	4.76E-13	0.164	1.08835E-07	1.78E-08
	2.00E+01	4.72E-09	3.50E-13	0.246	9.03977E-08	2.22E-08	1.04E-13	0.5881	2.67784E-08	1.57E-08
Total AD (rad/s)=					6.58436E-06	2.42E-07	Total AD (rad/s)=		9.26232E-07	8.01E-08
Total AD (mrad/hr) =					23.70369481	0.870554	Total AD (mrad/hr) =		3.334435322	0.288445

Detector Response for the X-720 Facility										
The source is located in the extreme south east corner of the building. (720_1)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	West Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	7.20E-14	0.0996	1.22802E-09	1.22E-10	2.04E-12	0.106	3.47745E-08	3.69E-09
	4.00E-01	1.08E-09	1.24E-13	0.1891	7.34975E-09	1.39E-09	2.50E-12	0.0586	1.47785E-07	8.66E-09
	9.00E-01	1.79E-09	1.15E-13	0.0845	1.12387E-08	9.5E-10	2.67E-12	0.0468	2.61434E-07	1.22E-08
	1.40E+00	2.44E-09	1.10E-13	0.3866	1.46323E-08	5.66E-09	1.44E-12	0.0562	1.92591E-07	1.08E-08
	1.85E+00	2.79E-09	5.11E-14	0.2193	7.79583E-09	1.71E-09	1.29E-12	0.0342	1.96433E-07	6.72E-09
	3.00E+00	3.22E-09	7.63E-14	0.0621	1.34328E-08	8.34E-10	3.11E-12	0.0261	5.47251E-07	1.43E-08
	6.43E+00	4.18E-09	3.39E-14	0.0654	7.74079E-09	5.06E-10	1.90E-12	0.027	4.34971E-07	1.17E-08
	2.00E+01	4.72E-09	5.69E-15	0.3394	1.46788E-09	4.98E-10	4.24E-13	0.2203	1.093E-07	2.41E-08
Total AD (rad/s)=					6.48861E-08	6.24E-09	Total AD (rad/s)=		1.92454E-06	3.64E-08
Total AD (mrad/hr) =					0.23358984	0.022474	Total AD (mrad/hr) =		6.928343058	0.130908

Detector Response for the X-720 Facility										
The source is located in the north west corner of the compressor pit, in the high bay. (720_2)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	West Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	4.77E-12	0.08	8.12891E-08	6.5E-09	1.76E-10	0.0297	2.99641E-06	8.9E-08
	4.00E-01	1.08E-09	5.95E-12	0.0446	3.51164E-07	1.57E-08	1.92E-10	0.0192	1.13322E-05	2.18E-07
	9.00E-01	1.79E-09	4.47E-12	0.026	4.37596E-07	1.14E-08	1.23E-10	0.0134	1.20565E-05	1.62E-07
	1.40E+00	2.44E-09	2.01E-12	0.057	2.67863E-07	1.53E-08	5.35E-11	0.0167	7.13793E-06	1.19E-07
	1.85E+00	2.79E-09	8.79E-13	0.0295	1.34053E-07	3.95E-09	2.68E-11	0.018	4.08582E-06	7.35E-08
	3.00E+00	3.22E-09	1.35E-12	0.0506	2.37585E-07	1.2E-08	3.66E-11	0.0202	6.44797E-06	1.3E-07
	6.43E+00	4.18E-09	5.33E-13	0.0586	1.21694E-07	7.13E-09	1.46E-11	0.0281	3.33512E-06	9.37E-08
	2.00E+01	4.72E-09	3.66E-14	0.2832	9.45718E-09	2.68E-09	5.54E-13	0.0407	1.42992E-07	5.82E-09
Total AD (rad/s)=					1.6407E-06	2.95E-08	Total AD (rad/s)=		4.75349E-05	3.56E-07
Total AD (mrad/hr) =					5.906525698	0.106084	Total AD (mrad/hr) =		171.1255624	1.281723

Detector Response for the X-720 Facility										
The source is located 100 feet east of the south east corner of the building. (720_3)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	West Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	6.79E-14	0.2174	1.15785E-09	2.52E-10	1.18E-12	0.1735	2.00906E-08	3.49E-09
	4.00E-01	1.08E-09	8.58E-14	0.1092	5.06325E-09	5.53E-10	1.46E-12	0.1021	8.62533E-08	8.81E-09
	9.00E-01	1.79E-09	1.29E-13	0.1201	1.259E-08	1.51E-09	1.51E-12	0.049	1.48139E-07	7.26E-09
	1.40E+00	2.44E-09	9.01E-14	0.1264	1.20165E-08	1.52E-09	8.70E-13	0.0747	1.16061E-07	8.67E-09
	1.85E+00	2.79E-09	1.32E-13	0.4135	2.01409E-08	8.33E-09	9.51E-13	0.068	1.45021E-07	9.86E-09
	3.00E+00	3.22E-09	1.71E-13	0.0661	3.00248E-08	1.98E-09	2.49E-12	0.0725	4.38398E-07	3.18E-08
	6.43E+00	4.18E-09	1.23E-13	0.0912	2.80089E-08	2.55E-09	1.81E-12	0.0301	4.13369E-07	1.24E-08
	2.00E+01	4.72E-09	1.69E-14	0.1482	4.36631E-09	6.47E-10	2.82E-13	0.049	7.27535E-08	3.56E-09
				Total AD (rad/s)=	1.13368E-07	9.23E-09			Total AD (rad/s)=	1.44009E-06
				Total AD (mrad/hr) =	0.408126299	0.03323			Total AD (mrad/hr) =	5.184308864
										0.13908

Detector Response for the X-720 Facility										
The source is located 100 feet east of the south east corner of the building. (720_4)										
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	West Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	East Detector Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11									
5.47E+13	1.00E-08	6.03E-17			0	0			0	0
100% U-235	3.00E-08	2.46E-16			0	0			0	0
P = 1281 W	5.00E-08	3.69E-16			0	0			0	0
	1.00E-07	6.52E-16			0	0			0	0
	2.25E-07	1.40E-15			0	0			0	0
	3.25E-07	2.54E-15			0	0			0	0
	4.00E-07	3.37E-15			0	0			0	0
	8.00E-07	5.39E-15			0	0			0	0
	1.00E-06	8.37E-15			0	0			0	0
	1.13E-06	9.93E-15			0	0			0	0
	1.30E-06	1.13E-14			0	0			0	0
	1.77E-06	1.42E-14			0	0			0	0
	3.05E-06	2.20E-14			0	0			0	0
	1.00E-05	5.46E-14			0	0			0	0
	3.00E-05	1.70E-13			0	0			0	0
	1.00E-04	5.43E-13			0	0			0	0
	5.50E-04	2.46E-12			0	0			0	0
	3.00E-03	1.35E-11			0	0			0	0
	1.70E-02	7.20E-11			0	0			0	0
	1.00E-01	3.12E-10	9.43E-14	0.1584	1.60848E-09	2.55E-10	2.14E-12	0.0738	3.6499E-08	2.69E-09
	4.00E-01	1.08E-09	1.94E-13	0.233	1.14432E-08	2.67E-09	2.77E-12	0.0633	1.63485E-07	1.03E-08
	9.00E-01	1.79E-09	2.12E-13	0.0634	2.07173E-08	1.31E-09	3.37E-12	0.0448	3.30143E-07	1.48E-08
	1.40E+00	2.44E-09	1.23E-13	0.0797	1.63631E-08	1.3E-09	1.72E-12	0.0266	2.28836E-07	6.09E-09
	1.85E+00	2.79E-09	1.24E-13	0.0886	1.89852E-08	1.68E-09	1.91E-12	0.1105	2.90869E-07	3.21E-08
	3.00E+00	3.22E-09	2.33E-13	0.0463	4.10412E-08	1.9E-09	4.02E-12	0.0422	7.08427E-07	2.99E-08
	6.43E+00	4.18E-09	1.63E-13	0.0615	3.73151E-08	2.29E-09	2.92E-12	0.0251	6.68048E-07	1.68E-08
	2.00E+01	4.72E-09	1.90E-14	0.1155	4.91388E-09	5.68E-10	4.17E-13	0.0544	1.07719E-07	5.86E-09
				Total AD (rad/s)=	1.52388E-07	4.76E-09			Total AD (rad/s)=	2.53403E-06
				Total AD (mrad/hr) =	0.548595069	0.017125			Total AD (mrad/hr) =	9.122493213